

## 299-E33-38 (A4863) Log Data Report

### Borehole Information:

<b>Borehole:</b> 299-E33-38 (A4863)		<b>Site:</b> 216-B-47 Crib			
<b>Coordinates</b> (WA State Plane)		<b>GWL (ft)<sup>1</sup>:</b> 234.97	<b>GWL Date:</b> 12/03/2002		
<b>North</b>	<b>East</b>	<b>Drill Date</b>	<b>TOC<sup>2</sup> Elevation</b>	<b>Total Depth (ft)</b>	<b>Type</b>
137,594.49 m	573,591.16 m	April 1991	193.629 m	242.2	Cable Tool

### Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Stainless steel	2.0	6 1/2	6 3/16	3/32	+2.0	20.4
T304 stainless steel	0.8	4.25	4	0.125	+0.8	220.6
T304 stainless steel screen		4.25	4	0.055	220.6	241.6
Casing information is from field measurements and data reported in the well construction and completion report. The 4-in. casing size cannot be determined, because a threaded joint is exposed at the surface. Casing bottom is as reported from the well construction and completion summary (Ledgerwood 1993), adjusted to TOC.						

### Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements reported by HWIS<sup>3</sup>, Stoller field personnel, and Ledgerwood (1993). The depths have been adjusted to TOC. Zero reference is the top of the 6-in. casing. Surrounding the casing, the ground surface is a 3-ft x 3-ft x 6-in. concrete pad. According to Ledgerwood (1993), T304 stainless-steel 4-in. casing and screen were used in this borehole. An estimate of the screen thickness was obtained from John Auten, drilling engineer with CH2M Hill Hanford Group, Inc. An estimate of the casing thickness was based on prior measurements of T304 casing by Stoller logging engineers. The 6-in. casing appears to only be surface casing. Surface grout extends to 20.4 ft (Ledgerwood 1993). Below the grout, the borehole is sealed with bentonite crumbles to 210.1 ft and bentonite pellets from 210.1 to 214.5 ft (Ledgerwood 1993). Below the bentonite pellets, the screen is surrounded by silica sand to 241.6 ft (Ledgerwood 1993). Duratek Federal Services measured the depth-to-water and depth-to-bottom when they removed the groundwater pump and tubing.

### Logging Equipment Information:

<b>Logging System:</b>	Gamma 2B	<b>Type:</b>	SGLS (35%)
<b>Calibration Date:</b>	12/2002	<b>Calibration Reference:</b>	GJO-2002-384-TAC
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

### Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5/Repeat
Date	12/04/02	12/05/02	12/09/02	12/10/02	12/10/02
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	2.0	66.0	163.0	242.0	161.0

Log Run	1	2	3	4	5/Repeat
Finish Depth (ft)	16.0	15.0	65.0	162.0	138.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A <sup>4</sup>	N/A	N/A	N/A	N/A
Pre-Verification	BB155CAB	BB157CAB	BB158CAB	BB159CAB	BB159CAB
Start File	BB156000	BB157000	BB158000	BB159000	BB159081
Finish File	BB156014	BB157051	BB158098	BB159080	BB159104
Post-Verification	BB156CAA	BB157CAA	BB158CAA	BB159CAA	BB159CAA
Depth Return Error (in)	0	-0.5	-1	N/A	+1
Comments	No fine-gain adjustment.	No fine-gain adjustment.	Fine-gain adjustment made after file BB158000.	No fine-gain adjustment.	No fine-gain adjustment.

### **Logging Operation Notes:**

Zero reference was top of the casing. Logging was performed without a centralizer installed on the sonde. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (<sup>40</sup>K, <sup>238</sup>U, and <sup>232</sup>Th) verifier with serial number 082. On 12/04/02, prior to logging run 1, two pre-survey verifications were collected; the second file is named BB155BAB. The full-width at half-maximum value for the 609- and 1460-keV peaks are too broad and exceed the most recent acceptance criteria.

### **Analysis Notes:**

<b>Analyst:</b>	Sobczyk	<b>Date:</b>	2/19/03	<b>Reference:</b>	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The verification spectra were all outside the control limits, which were established on 12/05/2002. The verification spectra were all above the control limit for the 609-keV full-width at half-maximum value. The verification spectra were all above the control limit for the 1461-keV full-width at half-maximum value except for BB157CAA. Spectra BB158CAA and BB159CAB were above the control limit for the 2615-keV full-width at half-maximum value. Spectrum BB158CAB was above the control limit for peak counts per second (cps) at the 1461-keV photopeak, and spectrum BB158CAA was below the control limit for counts per second at the 1461-keV photopeak. The counts per second at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra were between 4 and 13 percent lower at the end of each day. Examinations of spectra indicate that the detector functioned normally during all of the logging runs, and the spectra are provisionally accepted.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2Bfeb03.xls), using parameters determined from analysis of recent calibration data. Zero reference is the top of the casing. On the basis of Ledgerwood (1993) and the gross gamma response, the casing configuration was assumed to be one string of 6-in. surface casing to a log depth of 20.4 ft, one string of 4-in. casing to 220.6 ft, and 4-in. screen to the maximum depth of the log. Casing correction factors were calculated assuming a total casing thickness of 0.219 in. from 0 to 20.4 ft, 0.125 in. from 20.4 to 220.6 ft, and 0.055 in. from 220.6 to 242 ft. These are the measured values for these casing materials. Where more than one casing exists at a depth, the casing correction is additive (e.g., 0.0938 + 0.125 = 0.219 would be the combined thickness for the 6-in. and 4-in. casings). A water correction was applied to the SGLS data below 234.97 ft. Dead time corrections were not needed because dead time did not exceed 10.5 percent.

## **Log Plot Notes:**

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. In addition, comparison log plots of man-made radionuclides are provided to compare the data collected by Westinghouse Hanford Company (WHC) and Waste Management Federal Services NW's Radionuclide Logging System (RLS) with SGLS data. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The  $^{214}\text{Bi}$  peak at 609 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations on the combination plot rather than the  $^{214}\text{Bi}$  peak at 1764 keV because it exhibited slightly higher net counts per second.

## **Results and Interpretations:**

$^{137}\text{Cs}$  and  $^{60}\text{Co}$  were the man-made radionuclides detected in this borehole.  $^{137}\text{Cs}$  was detected in the borehole near the ground surface (4.0 to 6.0 ft) with a maximum concentration of 0.3 pCi/g at a log depth of 4.0 ft.  $^{137}\text{Cs}$  was detected at 56 and 57 ft with concentrations of 0.6 pCi/g and 2.0 pCi/g, respectively.  $^{137}\text{Cs}$  was also detected at 65 ft with a concentration of 0.2 pCi/g.  $^{60}\text{Co}$  was detected in the interval from 57.0 through 206.0 ft. The range of concentrations was from the MDL (0.1 pCi/g) to a maximum of 1.5 pCi/g, which was measured at 81.0 ft.

Recognizable changes in the KUT logs occurred in this borehole. However, these changes are more indicative of the well completion materials than the surrounding formation. The KUT logs show significant changes at 6, 21, 210, and 215 ft. These changes on the KUT logs are attributed to the change from cement grout to bentonite crumbles at 20.4 ft, the change from bentonite crumbles to bentonite pellets at 210.1 ft through 214.5 ft, and silica sand from 214.5 through 241.6 ft.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for both the man-made and natural radionuclides (661, 1173, 1333, 609, 1461, 1764, and 2614 keV).

Comparison log plots of data collected in 1991 and 1995 by WHC, in 1997 by Waste Management Federal Services, Inc., and in 2002 by Stoller are included. The concentration data for  $^{60}\text{Co}$  and  $^{137}\text{Cs}$  are decayed to the date of the SGLS logging event in December 2002 and shifted from a ground level reference to a TOC reference when applicable. In 1991, the borehole was logged by WHC before the well was completed. The apparent  $^{60}\text{Co}$  profiles are significantly different from one another.  $^{60}\text{Co}$  concentrations are markedly higher compared to the 1991 log, which was corrected for decay. These changes in  $^{60}\text{Co}$  profile are due to changes in contaminant distribution in the subsurface (Price et al. 1998). Since 1991,  $^{137}\text{Cs}$  activities appear to have decreased more than predicted by radioactive decay. The higher  $^{137}\text{Cs}$  concentrations detected by the WHC in 1991 are due to the fact that the addition of bentonite shielded the later logging from the formation (Price et al. 1998).

Because of this borehole's proximity to the significant vadose zone contamination attributed to the BY Cribs and BY Tank Farm, it is recommended that this borehole be periodically logged to establish rate of change in contaminant profile. The interval from 55 ft to total depth (241 ft) should be logged again in one year with the SGLS.

## **References:**

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev 0, Westinghouse Hanford Company, Richland, Washington.

Price, R.K., J.E. Meisner, and J.J. Dorian, 1998. *In Situ Spectral Gamma-Ray Survey Results of Selected Boreholes Associated with B-BX-BY Tank Farm Reassessment*, WMNW-9759114, Waste Management Federal Services, Inc., Richland, Washington.

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<sup>1</sup> GWL – groundwater level

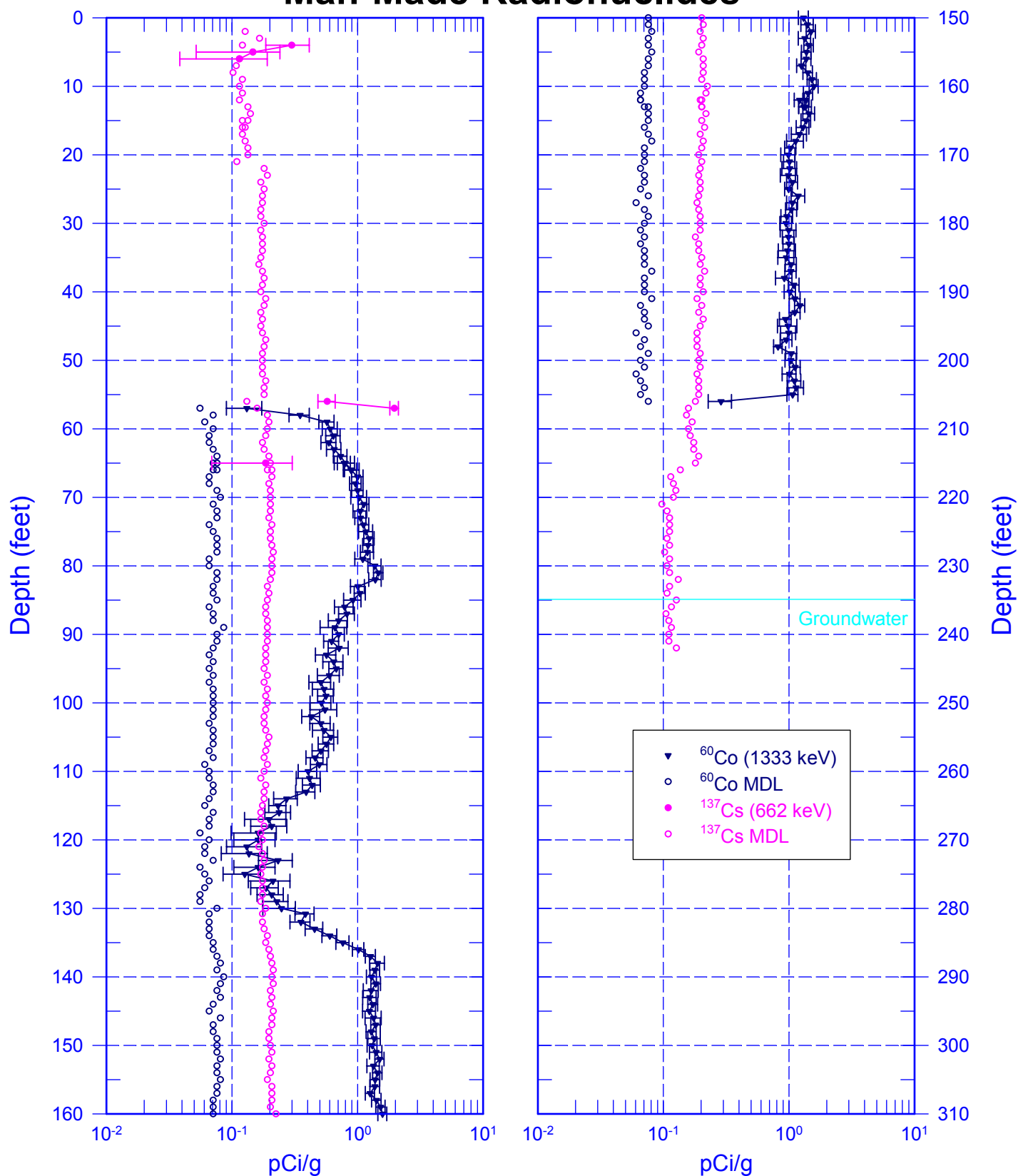
<sup>2</sup> TOC – top of casing

<sup>3</sup> HWIS – Hanford Well Information System

<sup>4</sup> N/A – not applicable

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## Man-Made Radionuclides

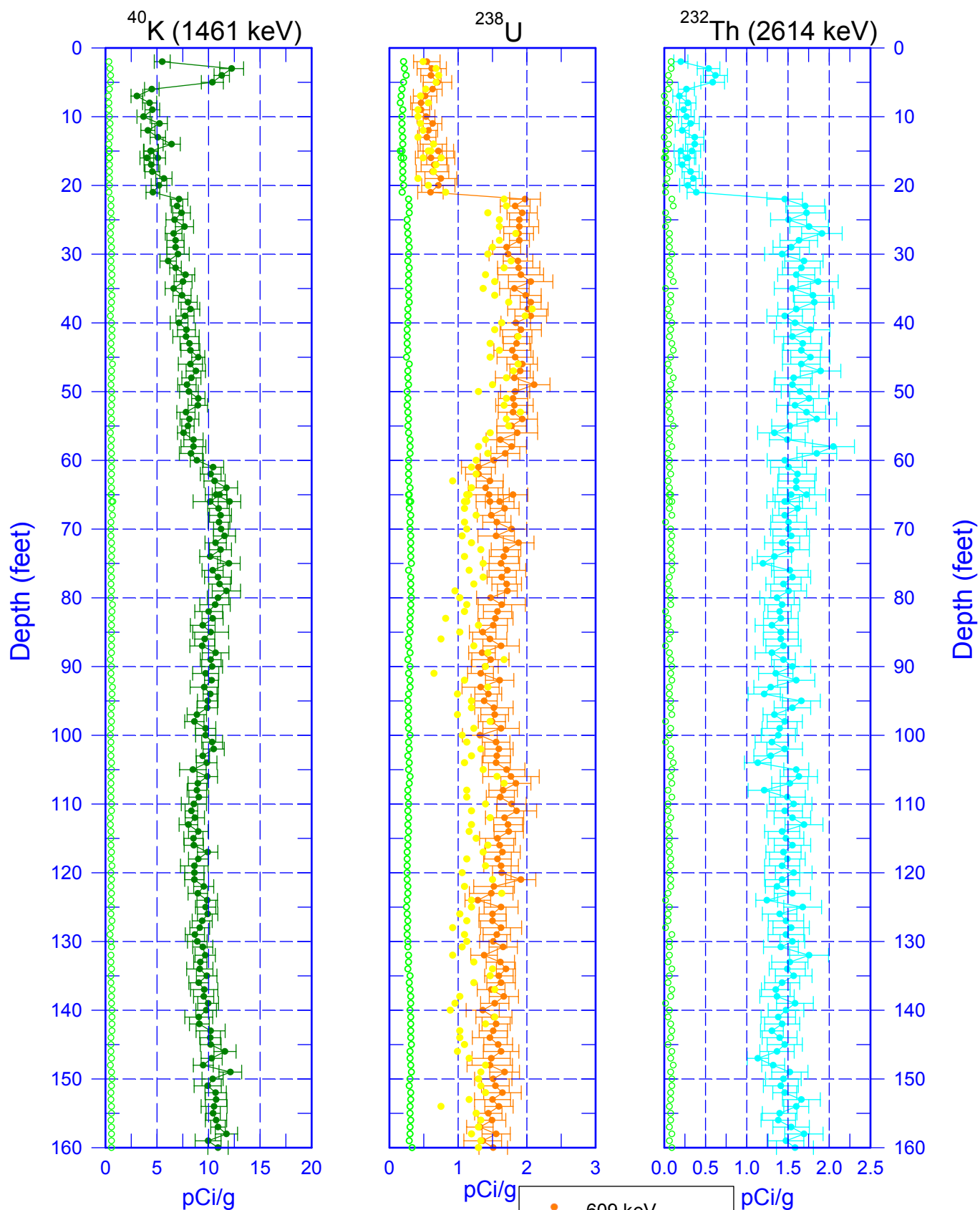


Zero Reference = Top of Casing

Date of Last Logging Run  
12/10/2002

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## Natural Gamma Logs

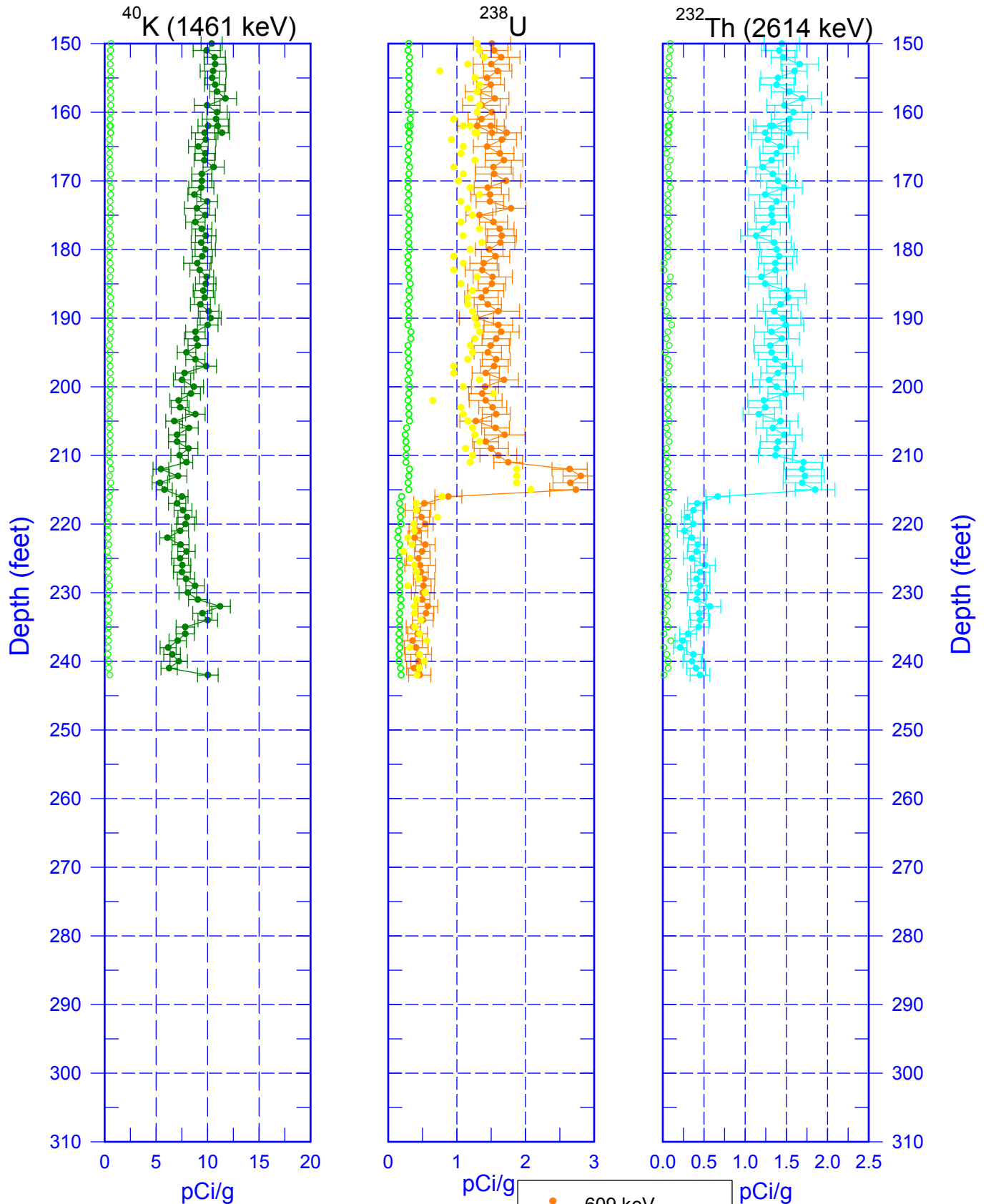


Zero Reference = Top of Casing

Date of Last Logging Run  
12/10/2002

# 299-E33-38 (A4863)

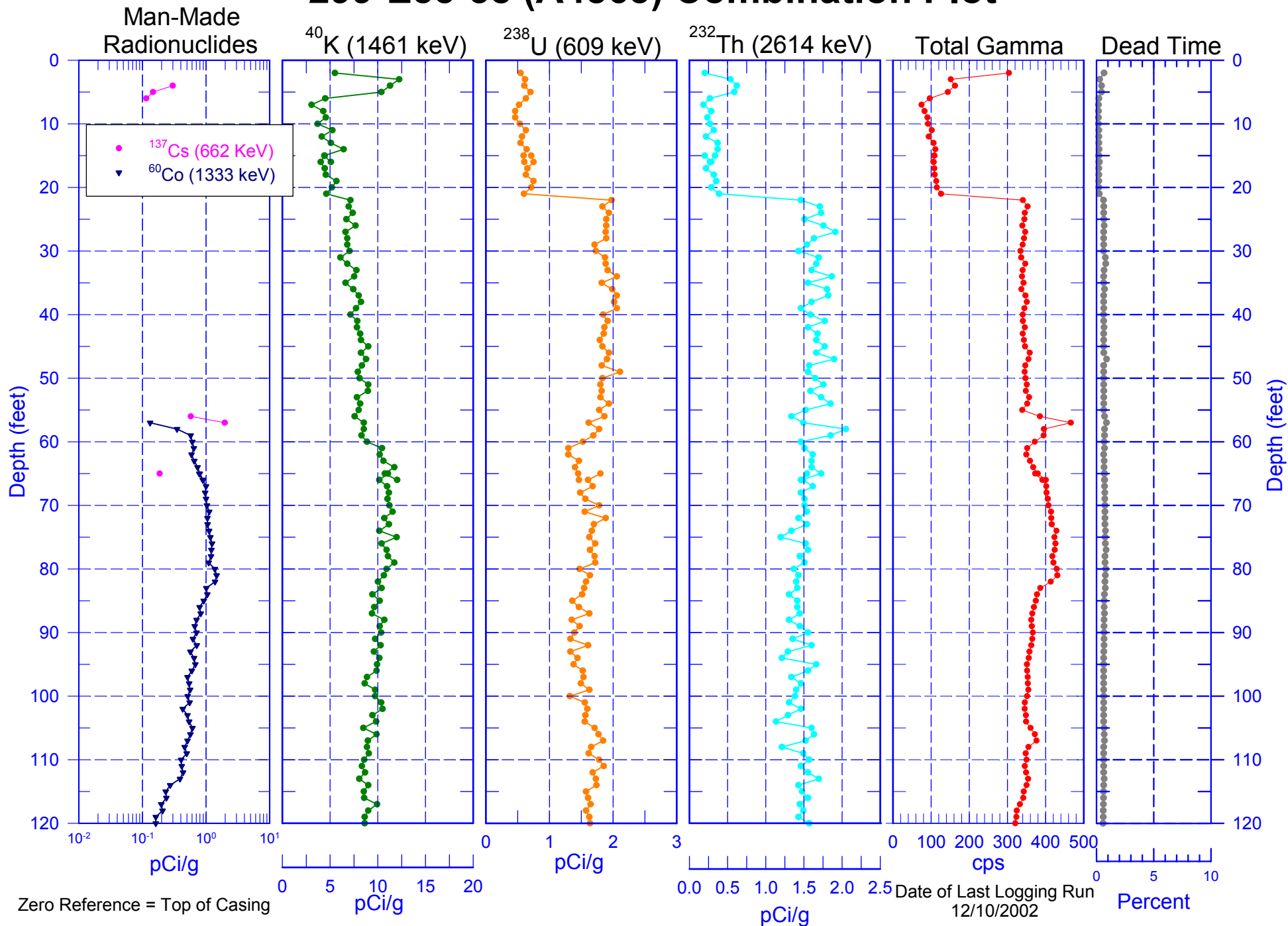
## Natural Gamma Logs



Zero Reference = Top of Casing

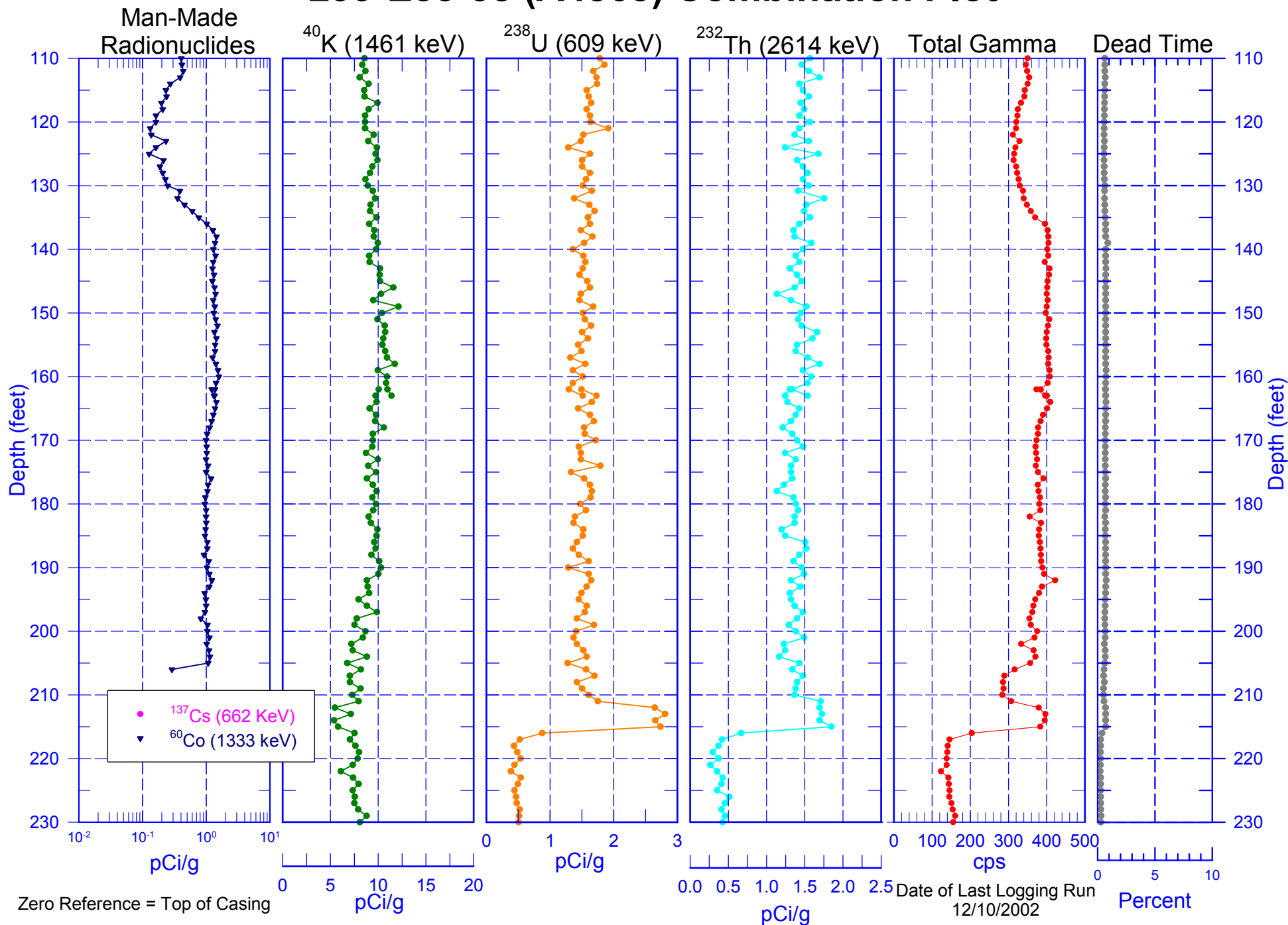
Date of Last Logging Run  
12/04/2002

# 299-E33-38 (A4863) Combination Plot

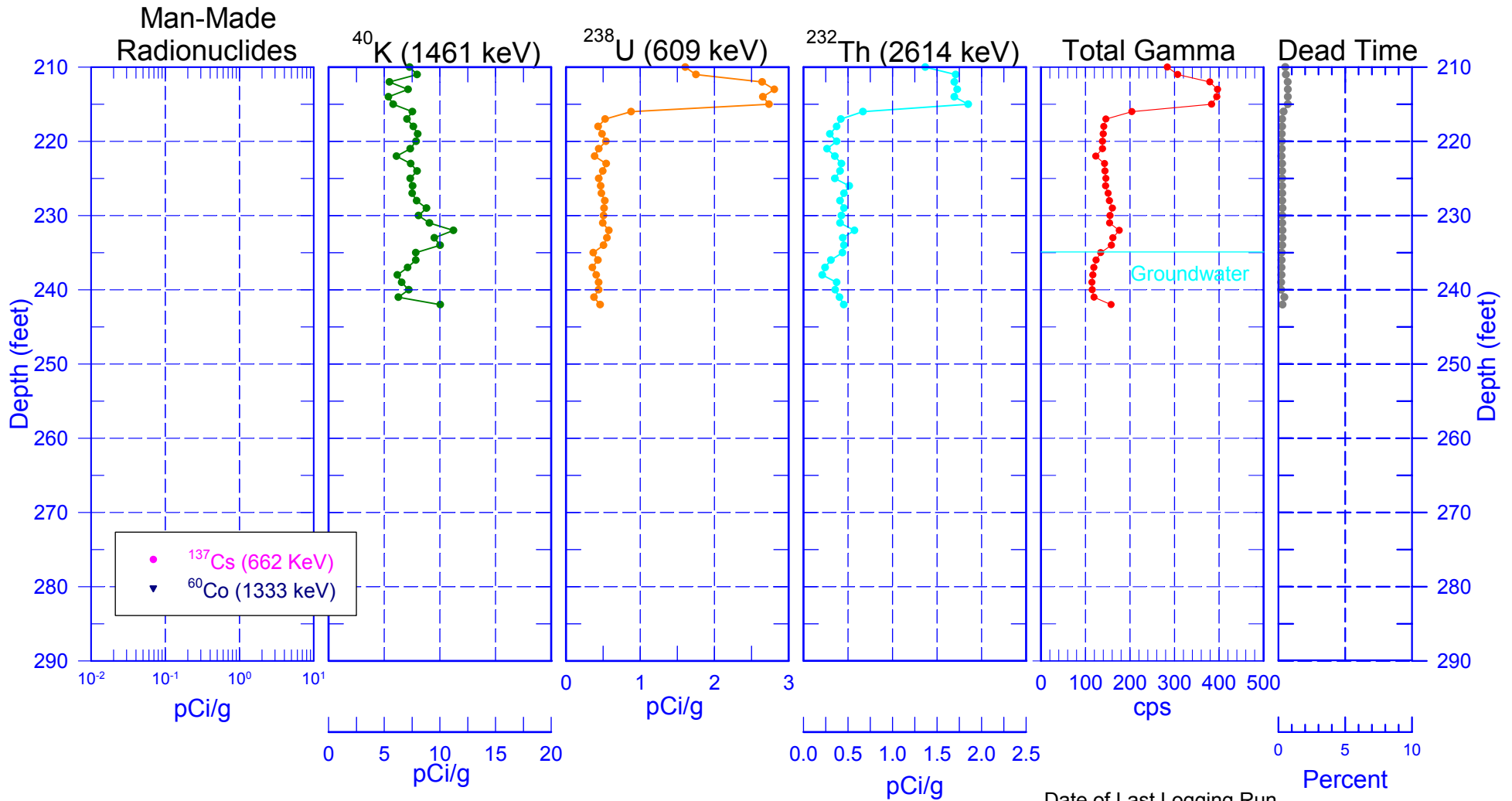




# 299-E33-38 (A4863) Combination Plot



# 299-E33-38 (A4863) Combination Plot

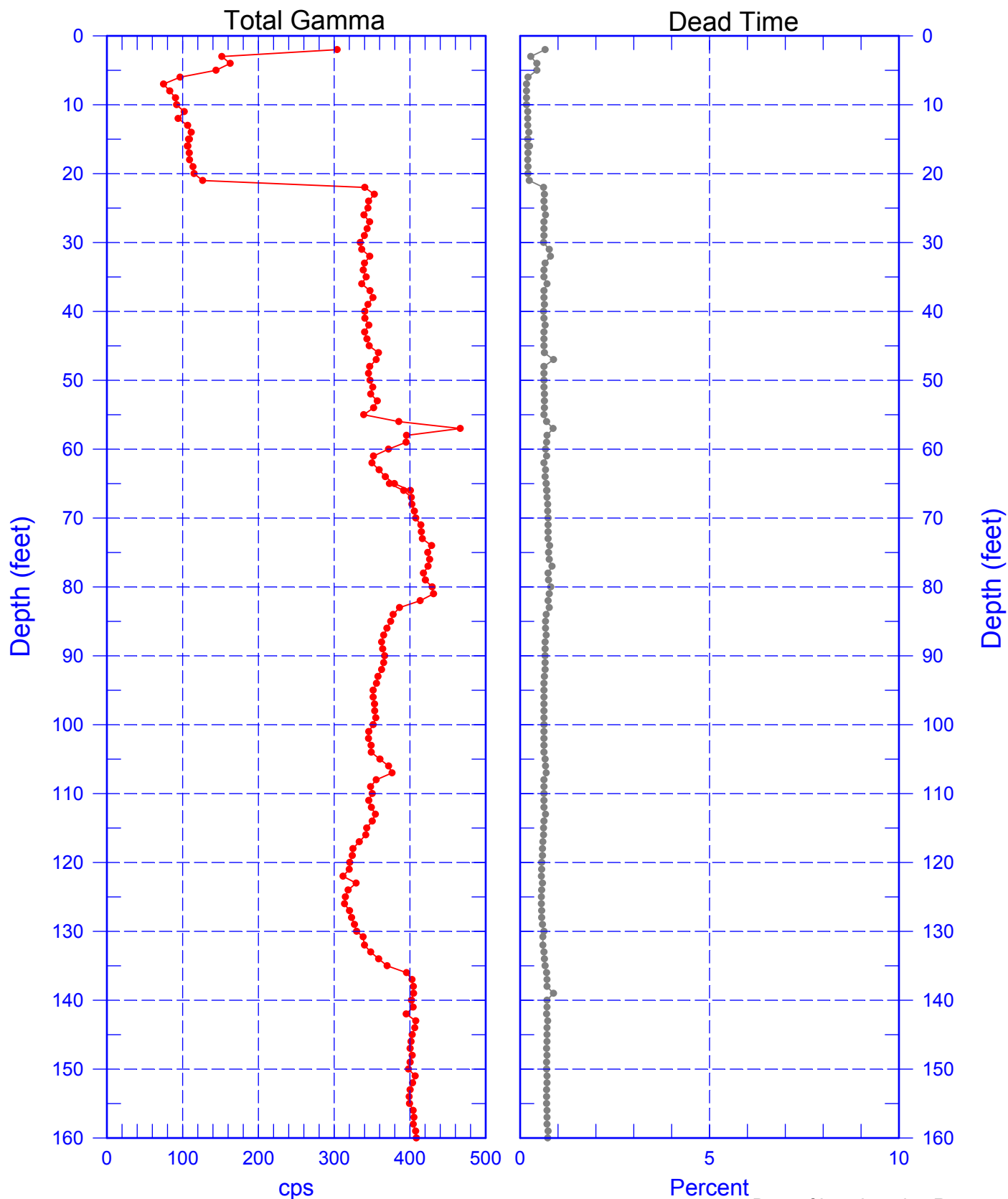


Zero Reference = Top of Casing

Date of Last Logging Run  
12/10/2002

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## Total Gamma & Dead Time

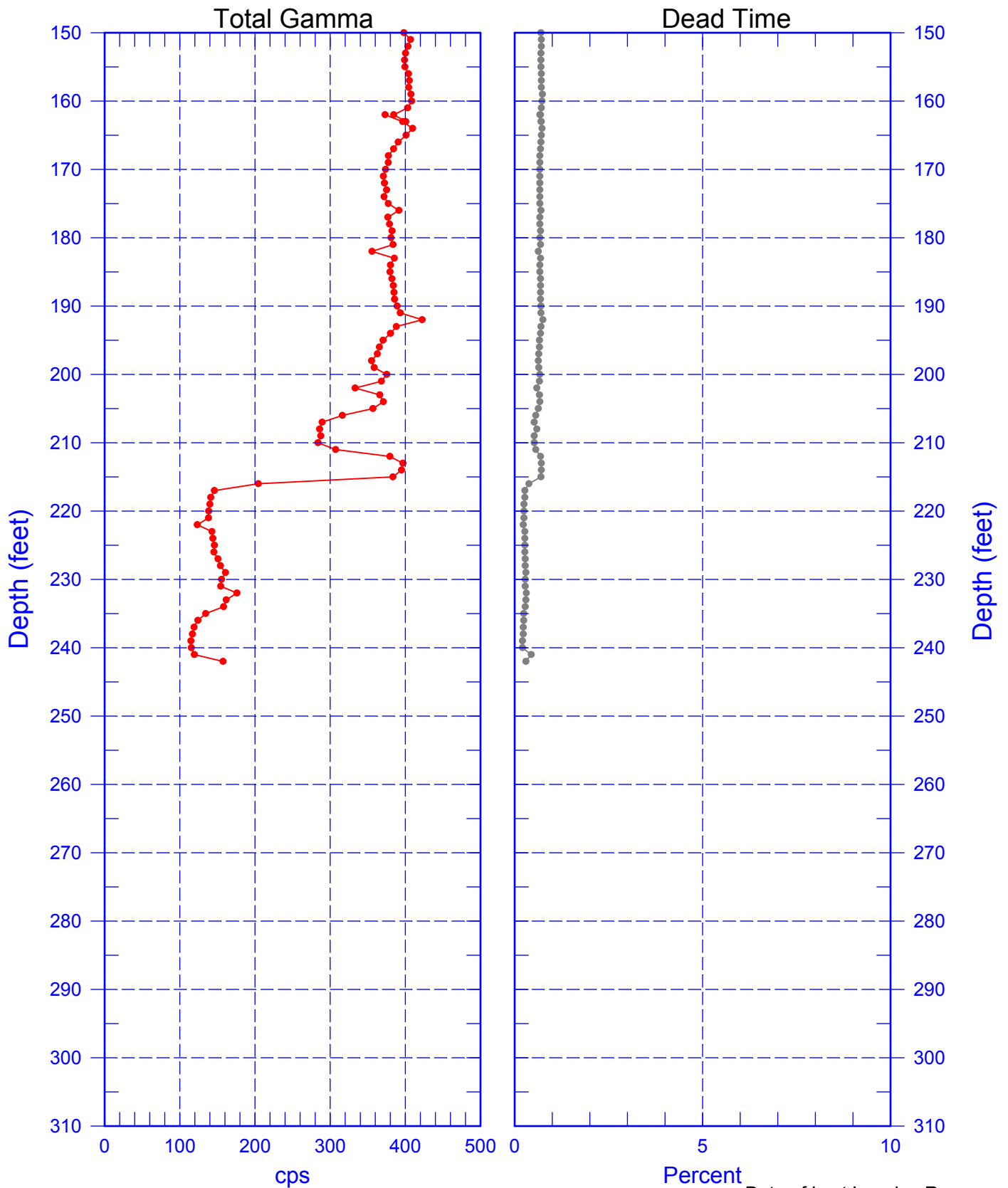


Zero Reference = Top of Casing

Date of Last Logging Run  
12/10/2002

# 299-E33-38 (A4863)

## Total Gamma & Dead Time

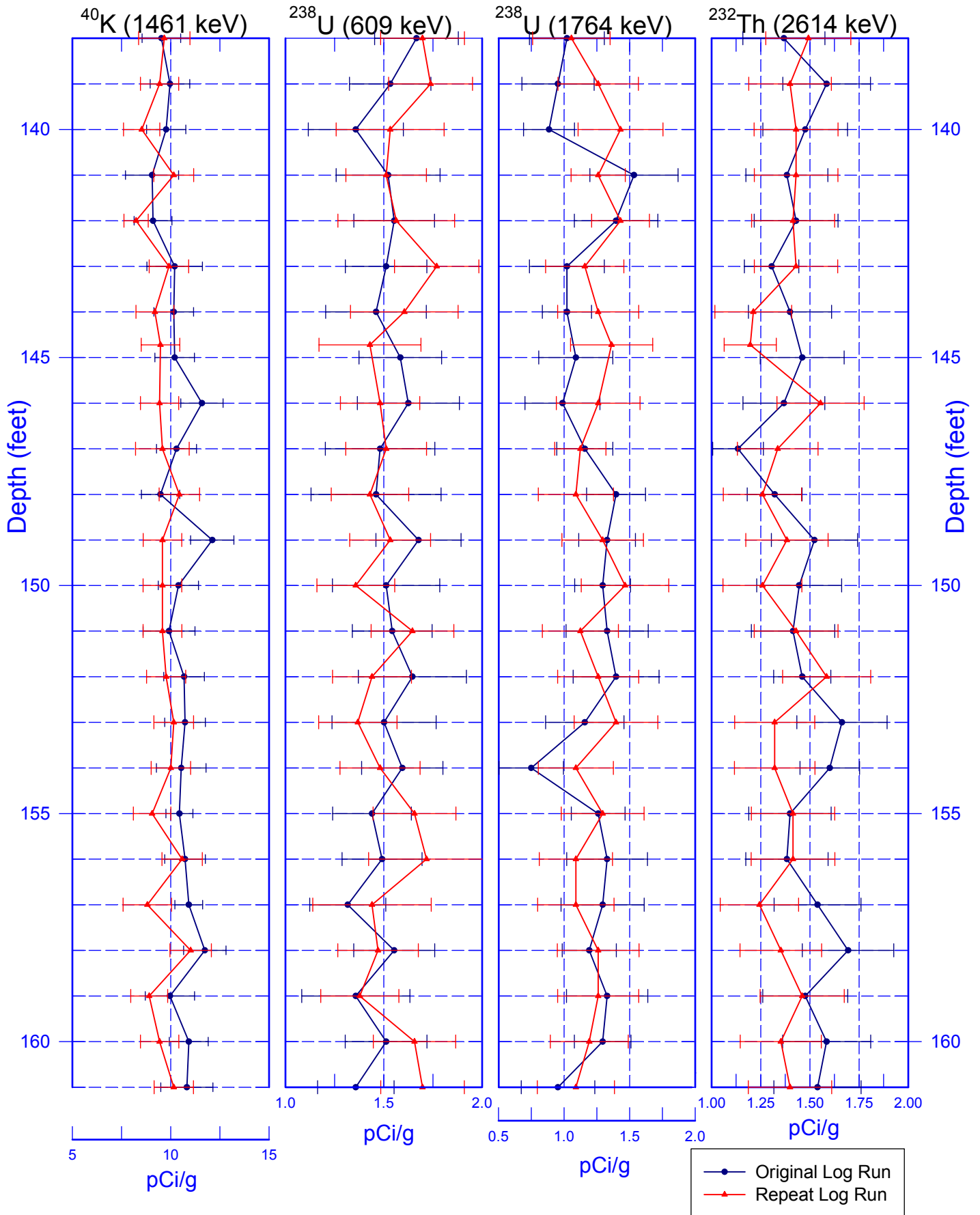


Zero Reference = Top of Casing

Date of Last Logging Run  
12/10/2002

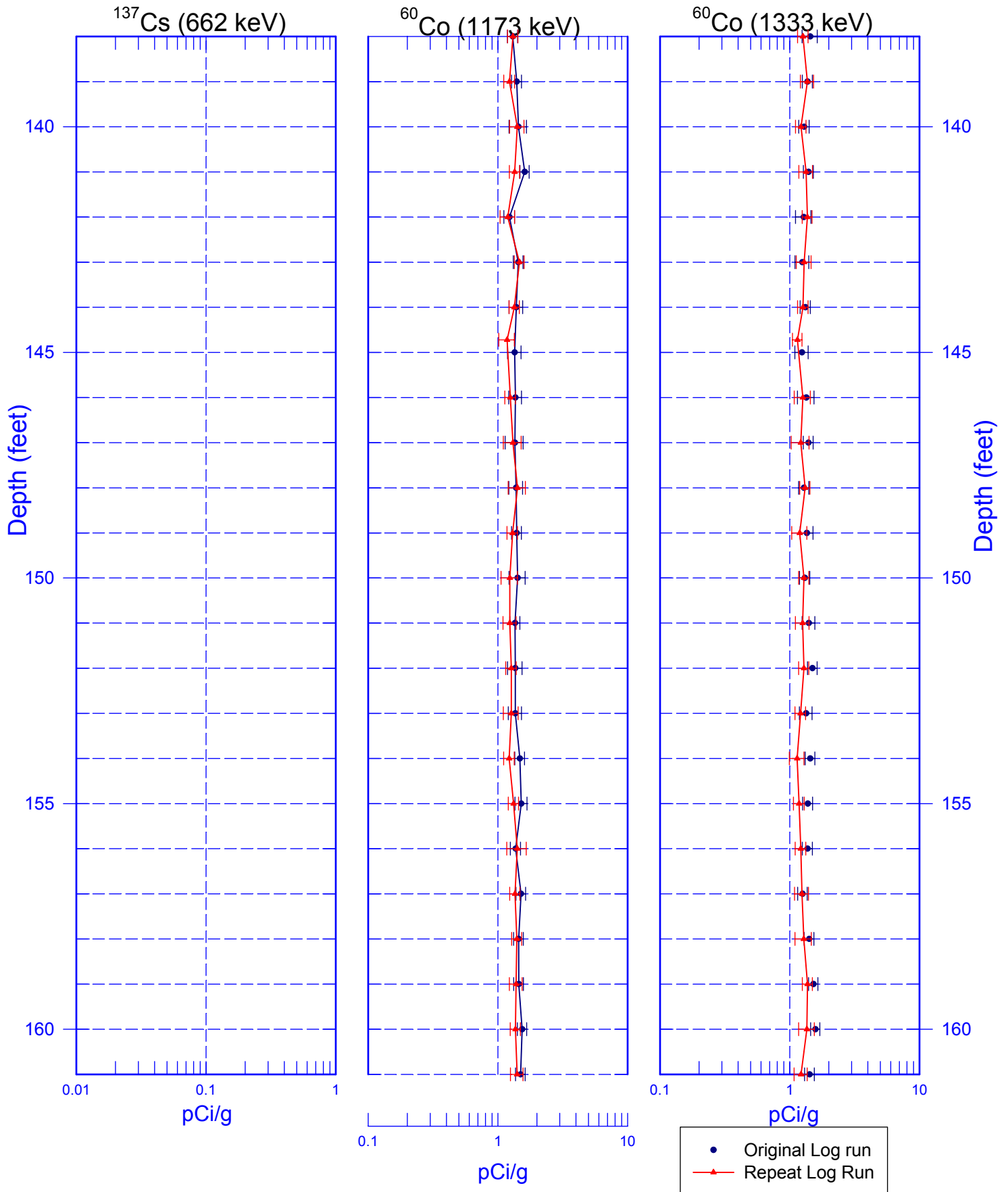
# 299-E33-38 (A4863)

## Rerun of Natural Gamma Logs (161.0 to 138.0 ft)



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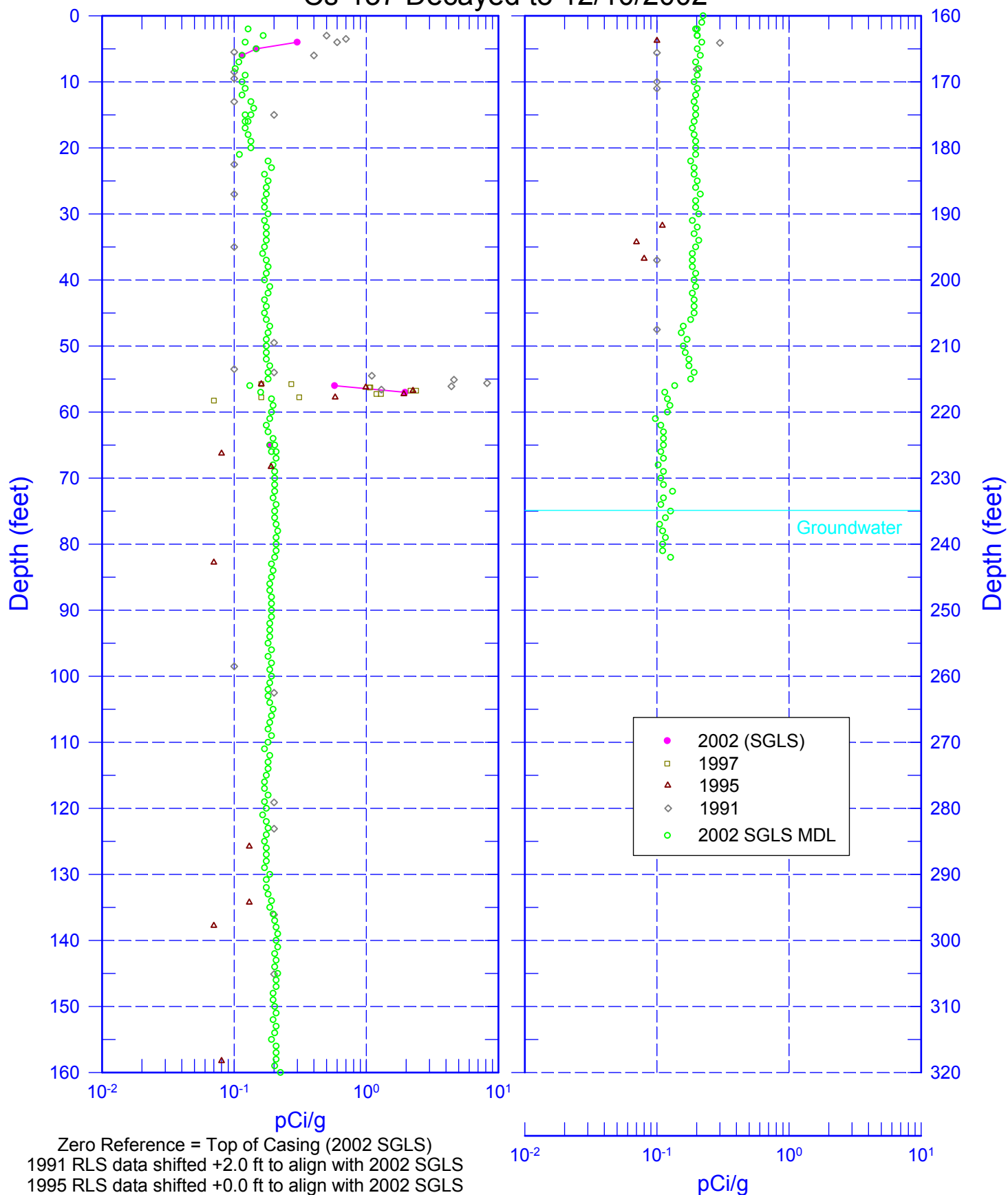
## Rerun of Man-Made Radionuclides (161.0 to 138.0 ft)



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RLS Data Compared to SGLS Data

Cs-137 Decayed to 12/10/2002



Zero Reference = Top of Casing (2002 SGLS)

1991 RLS data shifted +2.0 ft to align with 2002 SGLS

1995 RLS data shifted +0.0 ft to align with 2002 SGLS

1997 RLS data shifted +0.0 ft to align with 2002 SGLS

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RLS Data Compared to SGLS Data

Co-60 Decayed to 12/10/2002

